Environmental Impact Analysis Process

SUPPLEMENT TO THE
ENVIRONMENTAL ASSESSMENT
U.S. AIR FORCE, SPACE DIVISION
TITAN IV PROGRAM
CAPE CANAVERAL AIR FORCE STATION, FL
MAY 1988

DEPARTMENT OF THE AIR FORCE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE DIVISION (AFSC)
LOS ANGELES AIR FORCE STATION, PO BOX 92960, WORLDWAY POSTAL CENTER
LOS ANGELES, CA 90009-2960

5 JUL 1988

To: Governmental Agencies, Public Officials , Public Groups and Interested Individuals

Attached for thirty (30) days of pubic and governmental agency notification, in compliance with the National Environmental Policy Act and the regulations of the President's Council on Environmental Quality, is the Finding of No Significant Impact and the Supplement to the Environmental Assessment for the Titan IV Program at Cape Canaveral Air Force Station, FL.

The Titan IV Program, formerly known as the Complementary Expendable Launch Vehicle (CELV) Program, was addressed in a Finding of No Significant Impact and Environmental Assessment dated July 1986. The July 1986 Environmental Assessment addressed the modifications required at Launch Complex 41 to launch the Titan IV and the launching of two Titan IV space launch vehicles per year.

This Supplement to the Environmental Assessment and the Finding of No Significant Impact address the environmental consequences associated with increasing the launch rate of the Titan IV from two per ;year to six per year from Launch Complex 41, and the expansion of the Titan Vertical Integration Building (VIB) necessary to support the increase Titan IV launch rate from Cape Canaveral AFS, FL.

The thirty (30) day public and governmental agency notification period begins on July 8, 1988 and continues until August 8, 1988. Copies of the Finding of No Significant Impact and the Environmental Assessment may be obtained by writing to:

Department of the Air Force
Headquarters Space Division/DEV
Attn: Mr. Robert Mason
P.O. Box 92960
Los Angeles, CA 90009-2960

or by calling Mr. Mason at (213) 643-1409.

Sincerely

WILLIAM E. LEONHARD, JR., Colonel, USAF
Director of Acquisition Civil Engineering

SUPPLEMENT TO THE ENVIRONMENTAL ASSESSMENT FOR THE TITAN IV PROGRAM AT CAPE CANAVERAL AIR FORCE BASE, FLORIDA

May 1988

Prepared for: DEPARTMENT OF THE AIR FORCE
Headquarters Space Division
Environmental Planning Division
Directorate of Acquisition Civil Engineering

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
INCREASE IN LAUNCH RATE OF THE TITAN IV SPACE VEHICLE
CAPE CANAVERAL AIR FORCE BASE, FLORIDA

DESCRIPTION OF THE PROPOSED ACTION

INTRODUCTION

To support the Department of Defense (DOD) space program and to ensure access to space through the use of expendable launch vehicles, the U.S. Air Force (USAF) has proposed the renovation of Launch Complex 41 on Cape Canaveral Air Force Base (CCAFB) to support the Titan IV program. An Environmental Assessment (EA) was prepared for this program in July 1986 and resulted in a FONSI. Subsequent to the submittal of this EA, the USAF proposed to increase the Titan IV launch rate from two to six launches per year. In compliance with National Environmental Policy Act (NEPA) guidelines, a supplement to the EA for the Titan IV program has been prepared covering those actions associated with the proposed increase in launch rate.

PROPOSED ACTION

The USAF proposes to modify the Titan IV program and program support facilities. Specific actions addressed in this supplemental EA are as follows:

1. An increase in the projected number of launches from two per year to six per year,
2. Expansion of the Titan Vertical Integration Building (VIB) and associated infrastructure to provide for the processing of an increased number of payload fairings,
3. The addition of industrial processing facilities and the use of additional chemicals within the VIB expansion, and
4. The use of backup mobile electrical generation units at Launch Complex 41.

The Titan IV program is scheduled to achieve an initial launch capability of 1 October 1988.

SUMMARY OF ENVIRONMENTAL IMPACTS

NATURAL ENVIRONMENT

Air Quality

The proposed Titan IV program modifications will not significantly impact the air quality of CCAFB or surrounding areas. Primary constituents of the ground-level exhaust cloud produced by the solid rocket motors (SRMs) of the Titan IV will be carbon monoxide (CO), hydrogen chloride (HCl), and aluminum oxide (Al_2O_3). Because the nearest uncontrolled area is approximately 16 kilometers (10 miles) from the launch site, it is expected that the general population will not be exposed to HCl concentrations greater than the current Occupational Safety and Health Administration (OSHA) permissible limit of 5 parts per million (ppm). In addition, concentrations of CO and Al_2O_3 are predicted not to exceed the National Ambient Air Quality Standards (NAAQS) anywhere beyond the immediate area adjacent to the launch complex. Because of the short, infrequent nature of Titan IV launches and the limited impacts associated with individual launches, no significant reduction in air quality will result from increasing the frequency of launches from two to six per year.

Air pollution control devices at Launch Complex 41 will control the emissions of Aerozine 50 and nitrogen tetroxide (N_2O_4). In addition, spill control and containment facilities are sufficient to retain emergency or accidental spills of propellants and prevent release of hazardous vapors to the atmosphere.

Significant air quality impacts will not result from industrial operations in the VIB. Based on six launches per year, estimated particulate emissions will not exceed NAAQS. The types of volatile

organic compounds (VOCs) to be used in the VIB all have threshold limit values (TLVs), as established by the American Conference of Governmental Industrial Hygienists (ACGIH), well in excess of the concentrations that will result from the proposed operations.

Emissions associated with the operation of the backup mobile generators at Launch Complex 41 will not exceed any annual or short-term NAAQS.

Soils

The proposed expansion of the VIB facility and associated infrastructure will require about 7,650 cubic yards (yd^3) of fill material. Fill material will be clean sand obtained from a CCAFB upland borrow area. The total area to be filled will be approximately 2.36 acres. No other alteration to soil characteristics of CCAFB will result from the proposed modifications to the Titan IV program.

Hydrology

All water used to support the Titan IV program will be obtained from municipal water supplies. The annual volume of water used as deluge, fire suppressant, and washdown water will increase from 800,000 gallons (gal) for two launches to 2.4 million gallons (MG) for six launches. Some ground water recharge will occur as the result of this water flowing off the launch pad or being discharged to grade.

Titan IV program modifications will result in minor staffing increases at Launch Complex 41 and the VIB and associated increases in wastewater loads. Domestic wastewaters at Launch Complex 41 and the VIB are treated at onsite extended aeration sewage treatment plants (STPs). These STPs are permitted by the Florida Department of Environmental Regulation (FDER) and discharge to infiltration systems that allow the treated wastewaters to percolate to ground waters. Wastewater loads at both Launch Complex 41 and the VIB will be well within STP design capacities.

Following discharge to grade, launch water and wastewater at Launch Complex 41 will percolate into the ground water table and flow west toward the Banana River. Water discharged from the VIB wastewater facility will percolate to the ground water table and flow toward a tidal lagoon, which is connected via culvert to the Banana River.

No significant impacts to ground water or surface water hydrology will result from the Titan IV program.

Water Quality

No significant long-term adverse impacts to ground water or surface water quality will occur as a result of the Titan IV program. All deluge water and fire suppressant water collected in the flame bucket will be analyzed prior to discharge to grade. If this water is contaminated, it will be removed and disposed in accordance with the CCAFB Hazardous Waste Management Plan. Spill control and containment facilities are provided for all fuel tank areas to prevent the accidental release of propellants to the environment. The potential exists for a short-term, localized impact on water quality in the unlikely event of an early inflight failure of the Titan IV vehicle. Due to the hypergolic nature of the liquid fuels and the activation of the vehicle destruct system following a near-pad flight failure, minimal contamination of surface waters is expected following such an event.

Surface water quality will not be significantly impacted by deposition of HCl or Al_2O_3 from the ground cloud produced during liftoff of the Titan IV vehicle. Any HCl deposited in surrounding marine and estuarine surface waters will be rapidly neutralized by the extensive buffering capacity of these waters. In addition, any Al_2O_3 deposited in surface waters will remain insoluble and will not be toxic to aquatic life.

Impervious areas at the VIB facility will increase by approximately 1.58 acres as a result of VIB expansion and the paving of additional

areas for roads and parking. Stormwater runoff will be collected in a swale system and retained in a basin located adjacent to the VIB. Most of the water collected in this system will infiltrate into the ground water table. This stormwater system has been approved by the State of Florida and will not result in the significant degradation of ground water or surface water quality.

The STPs at Launch Complex 41 and the VIB facility have design capacities well in excess of anticipated loads. These STPs will provide for adequate waste treatment and will not cause significant ground water quality degradation.

Biota

The proposed Titan IV program modifications are not expected to significantly impact terrestrial, wetland, or aquatic biota in the CCAFB vicinity. All proposed activities at Launch Complex 41 will be conducted within the existing launch complex boundary and will not result in the loss of any additional habitat. Wildlife in the vicinity of Launch Complex 41 have adapted to disturbances associated within normal operations and launch events. Terrestrial and aquatic biota will not be significantly impacted by ground-level exhaust clouds.

The expansion of the VIB and associated infrastructure will not result in the significant loss of wetlands or other areas critical to the support of wildlife resources. Permit approvals for this action have been obtained from FDER and the U.S. Army Corps of Engineers. Operations conducted at the VIB will not adversely affect local biota.

MANMADE ENVIRONMENT

Population

Titan IV program modifications will have no significant impacts on population and housing on CCAFB or surrounding communities. The Titan IV program will utilize existing personnel available at CCAFB, Patrick Air Force Base (PAFB), or surrounding communities.

Socioeconomics

The Titan IV program is compatible with current and projected future land uses on CCAFB. The proposed program modifications will not require new utility services, social services, or additional transportation access. No significant impacts to the socioeconomics of CCAFB or Brevard County, Florida, are anticipated.

Noise

Noise associated with the Titan IV program will not significantly affect the general public. Noise associated with launches is infrequent and of short duration.

Archaeology and Cultural Resources

Facility expansions required for the proposed Titan IV program modifications are minor and will occur on previously disturbed lands. Because no undisturbed lands will be affected by the proposed actions, no impacts to archaeological or cultural resources will occur.

FINDINGS

Based on the preceding discussion, a finding of no significant impact is made. An EA for the Titan IV program and a supplement to the EA, which addresses proposed program modifications, are on file at:

Headquarters Space Division
P.O. Box 92960
Worldway Postal Center
Los Angeles, California 90009
Attention: Mr. Robert C. Mason SD/DEV

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LIST OF ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
Aerozine 50	50-percent 1,1-dimethyl hydrazine and 50-percent hydrazine
$AlCl_3$	aluminum chloride
Al_2O_3	aluminum oxide
C^-	carbon anion
CCAFB	Cape Canaveral Air Force Base
CELV	Complementary Expendable Launch Vehicle
CEQ	Council of Environmental Quality
cfs	cubic feet per second
CH^-	ionized hydrocarbon
CMP	Coastal Management Plan
CO	carbon monoxide
CO_2	carbon dioxide
COE	U.S. Army Corps of Engineers
DOD	Department of Defense
EA	Environmental Assessment
ESE	Environmental Science and Engineering, Inc.
FDER	Florida Department of Environmental Regulation
FGFWFC	Florida Game and Fresh Water Fish Commission
FONSI	finding of no significant impact
ft	feet
ft^2	square feet
FVIS	fuel vapor incinerator system
gal	gallon
gpd	gallons per day
H_2	hydrogen molecule
HCl	hydrogen chloride
H_2O	water
km	kilometer

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 2 of 3)

KSC	Kennedy Space Center
kW	kilowatt
lb	pound
lb/hr	pounds per hour
LTDs	launch test directives
MAC	maximum acceptable concentration
MEK	methylethyl ketone
MG	million gallons
mg/m^3	milligrams per cubic meter
MISB	Motor Inert Storage Building
N_2O_4	nitrogen tetroxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NO_2	nitrogen dioxide
N_2O_4	nitrogen tetroxide
NO_x	nitrogen oxides
OSHA	Occupational Safety and Health Administration
OVSS	oxidizer vapor scrubber system
PM	particulate matter
ppm	parts per million
SJRWMD	St. Johns River Water Management District
SO_2	sulfur dioxide
SRM	solid rocket motor
STP	sewage treatment plant
TLV	threshold limit value
TPY	tons per year
ug/m^3	micrograms per cubic meter
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 3 of 3)

VAFB	Vandenburg Air Force Base
VIB	Vertical Integration Building
VOCs	volatile organic compounds
yd^3	cubic yard

1.0 PROPOSED ACTION AND ALTERNATIVES

In support of the Department of Defense (DOD) space program, the U.S. Air Force (USAF) has proposed to renovate and modify Launch Complex 41 at Cape Canaveral Air Force Base (CCAFB), FL, to accommodate the Titan IV program, previously referred to as the Complementary Expendable Launch Vehicle (CELV) program. In compliance with the National Environmental Policy Act (NEPA) and Council of Environmental Quality (CEQ) guidelines, the USAF prepared a comprehensive Environmental Assessment (EA) to address potential impacts associated with the Titan IV program. This EA, completed in July 1986, supported a Finding of No Significant Impact (FONSI) for the Titan IV program at CCAFB.

Subsequent to the preparation of the July 1986 EA (3) (hereafter referred to as the 1986 CELV EA), a proposal was made to increase the launch rate of the Titan IV from two launches per year to a maximum of six per year, beginning in 1988 and continuing through 1993. This maximum launch rate of six per year includes the possible launching of Titan IV space vehicles by commercial firms. In 1984, the President signed into law the Commercial Space Launch Act (PL 98-575) which allows commercial firms to obtain licenses from the U.S. Department of Transportation to use U.S. government facilities to launch commercial space vehicles. Currently there are no proposals for commercial launches of Titan IV space vehicles from Launch Complex 41 at CCAFB. However, if a commercial firm is granted a license to launch a Titan IV from Launch Complex 41 at CCAFB in the future, and the licensed launch or launches does not exceed the maximum launch rate of six per year, those launches will be covered by the 1986 CELV EA and this Supplement to the EA for the Titan IV program. This is based upon the finding that the environmental impacts of a commercial launch of a Titan IV from Launch Complex 41 would be the same as those associated with a government launch of a Titan IV, which

are documented in the 1986 CELV EA and this Supplement as long as the launch rate does not exceed a total of six per year.

The increase in launch rate from two per year to six per year will require several modifications and additions to Titan IV support facilities on CCAFB. To maintain compliance with all applicable Federal regulations, the USAF has prepared the following supplement to the 1986 CELV EA. This supplement will address potential environmental and socioeconomic impacts associated with the increase in Titan IV launch rate to six per year and the proposed modifications to Titan IV support facilities at CCAFB. This supplement is a companion document to the 1986 CELV EA. For a discussion of the environmental impacts of the overall Titan IV program at CCAFB, refer to the 1986 CELV EA.

1.1 PROPOSED ACTION

The USAF, Headquarters Space Division, Los Angeles, CA, proposes to modify the Titan IV program. Specific program and facilities modifications which are addressed in this supplemental EA are:

1. An increase in the projected number of launches from two per year to six per year,
2. Expansion of the existing Titan Vertical Integration Building (VIB) and associated support infrastructure to allow for the processing of the increased number of payload fairings required to support six launches per year,
3. The addition of industrial processing facilities and the use of additional hazardous chemicals within the VIB expansion, and
4. The use of additional backup mobile electrical generation units at Launch Complex 41.

A base map of CCAFB, showing the location of facilities including Launch Complex 41 and the VIB, is presented in Fig. 1.1-1. Proposed VIB modifications will result in the expansion of the building's area by

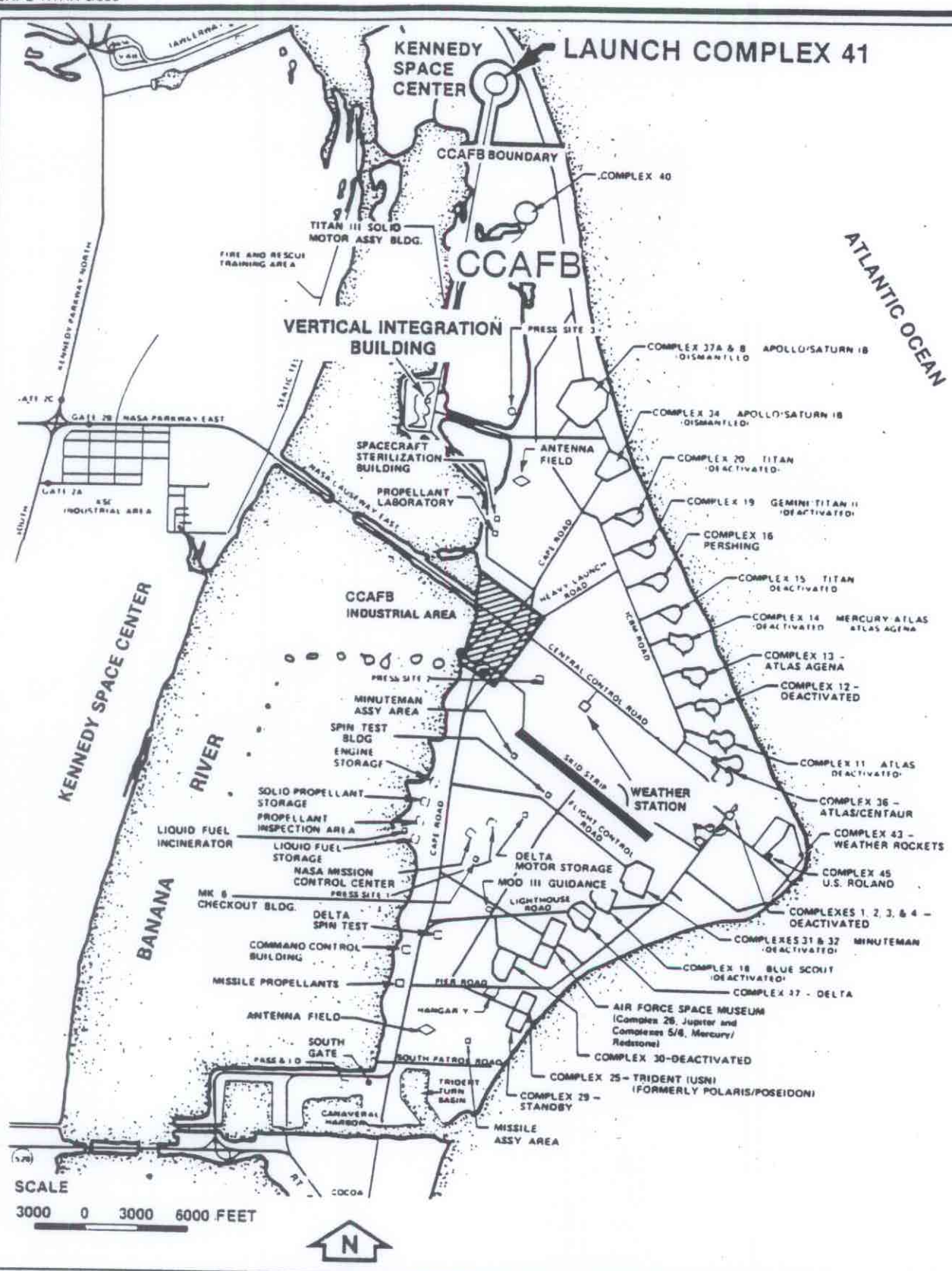

Figure 1.1-1
BASE MAP

SOURCE: 4.

TITAN IV PROGRAM
Supplemental Environmental Assessment
Cape Canaveral Air Force Base

30,900 square feet (ft^2). Included in the addition to the VIB are two paint spraybooths, solvent tanks, and other industrial processing facilities. An increase in parking and driveway areas of less than 1 acre is also proposed.

To ensure sufficient power is available at the launch site to support the revised launch schedule, several mobile electric generators will be required at Launch Complex 41.

1.2 ALTERNATIVE ACTIONS

Alternative actions to the projected increase in number of launches from two to six per year, with the associated facility modifications in the VIB and Launch Complex 41 areas, are discussed in the following sections.

1.2.1 Alternative Launch Frequencies

The alternatives to increasing the launch rate of the Titan IV from two to six launches per year include transferring the payloads to the Space Shuttle, which would delay the required launch dates and compromise national defense requirements; or selection of an alternative launch site at other CCAFB launch facilities. The transferrals of the four additional payloads per year to the Space Shuttle would result in delays in meeting critical DOD space missions because of Space Shuttle delays and insufficient capacity to accommodate the additional USAF program launch requirements.

1.2.2 Alternative Launch Sites

The relocation of either the entire Titan IV program or of the additional four launches per year to an alternative site would result in similar environmental impacts if an existing launch facility were available, or increased environmental impacts and costs if a new launch site were constructed. Both the modification of an existing launch complex to

support Titan IV launches or the construction of a new facility would result in significantly higher costs and environmental impacts.

Currently there are only two sites from which the Titan IV can be launched, those being CCAFB, FL, and Vandenberg Air Force Base (VAFB), CA. Launch constraints do not allow for launches over populated areas, which limit the capability to launch Titan IV vehicles and payloads from CCAFB and VAFB into specific orbits. As a result, launches from CCAFB are into equatorial orbits, whereas launches from VAFB are into polar orbits. Therefore, those Titan IV payloads requiring equatorial orbits must be launched from CCAFB. Since launch facilities are designed and constructed to launch a specific vehicle, the Titan IV cannot be launched from other CCAFB launch complexes unless they are extensively modified.

1.2.3 Alternative Payload Fairing Processing Facilities

Alternative actions to the CCAFB VIB modifications include the construction of a new facility to process the increased number of payload fairings associated with the additional Titan IV launch vehicles and other industrial processes and processing activities. The Motor Inert Storage Building (MISB) was scheduled to accommodate payload fairing processing activities for two Titan IV launches per year. However, the MISB has insufficient capacity to accommodate such activities for the increased rate of six launches per year. As such, the VIB modifications were selected as the most cost-effective and environmentally compatible option. The associated engineering, process, and permit requirements for constructing a new, stand-alone facility would be considerably more complex than the proposed action, while the environmental impacts would likely be significantly higher.

1.2.4 Alternative Electric Generation Facilities

Alternative actions to the use of mobile electrical generators at Launch Complex 41 include the construction of permanent, onsite electrical

generators. This option would result in significantly higher onsite and offsite environmental impacts and costs than the proposed alternative. These mobile generators are not dedicated to the Titan IV program, but may be used throughout CCAFB on an as-needed basis. This ability to use electrical generators at different launch complexes and CCAFB facilities is the most cost-effective option and minimizes environmental impacts.

1.3 NO-ACTION ALTERNATIVE

The no-action alternative would require that the additional four payloads per year scheduled to fly on the Titan IV be launched from the Space Shuttle, that another launch complex at CCAFB be modified for the launching of the Titan IV, or that the additional four payloads not be launched. No vehicle other than the Space Shuttle can lift payloads designed for the Titan IV into orbit. Because of delays in the Space Shuttle program and uncertainty as to whether the program can accommodate the additional launch requirements, use of the Space Shuttle would jeopardize the delivery of critical national defense payloads into space. The use of the Space Shuttle would also result in environmental impacts which are documented in the Final Environmental Impact Statement for the Kennedy Space Center (KSC) (13). Modification of another launch complex at CCAFB to launch the Titan IV would also result in environmental impacts as well as schedule delays. A decision not to launch the additional four payloads would impact national security.

Similarly, the no-action alternative to the proposed facility modifications in the VIB or Launch Complex 41 areas would compromise the USAF's capability to increase the Titan IV launch rate from two to six launches per year, resulting in the loss of critical national defense payload deliveries.

2.0 ENVIRONMENTAL DESCRIPTION AND IMPACTS

2.1 NATURAL ENVIRONMENT

Activities associated with proposed modifications to the Titan IV program will take place at Launch Complex 41 and the VIB. The locations of these sites are shown in Fig. 1.1-1. The environmental settings of CCAFB and Launch Complex 41 have been described in detail in the 1986 CELV EA. Launch Complex 41 is located on the northernmost portion of CCAFB, approximately 2,000 feet (ft) from the Atlantic Ocean and about 3,000 ft from the Banana River. Coastal strand vegetation surrounds this facility. The nearest wetland lies about 700 ft west of this launch site. All proposed activities at Launch Complex 41 will take place within existing launch complex boundaries.

The VIB is located on a man-made island in the Banana River which is connected by three causeways to the remainder of CCAFB. This island was largely constructed during the 1960s as part of a large dredge-and-fill operation at CCAFB. The VIB lies to the east of a shallow man-made lagoon which is connected via culvert to the Banana River. Wetland vegetation surrounds the island and borders the interior lagoon. Low, sparse grasses cover most of the unpaved upland portions of the island.

2.1.1 Air Quality

2.1.1.1 Existing Air Quality and Meteorology--

Air quality at CCAFB is considered good. Brevard County is classified as an attainment area for all air pollutants for which National Ambient Air Quality Standards (NAAQS) have been promulgated. These include particulate matter (PM), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone, and lead.

A more detailed description of the existing air quality and meteorology is presented in the 1986 CELV EA.

2.1.1.2 Sources of Air Emissions--

The principal sources of air pollutant emissions associated with the modified Titan IV program are:

1. Launch vehicle exhaust (combustion products),
2. Fueling operations,
3. Related industrial operations, and
4. Backup mobile generators.

These emission sources are discussed in the following paragraphs.

Launch vehicle emissions are described in detail in the 1986 CELV EA. Emissions on launch are produced by the firing of two solid rocket motors (SRMs). Liquid fuel is ignited 115 seconds after SRM firing, when the vehicle is approximately 30 miles downrange at an altitude of approximately 160,000 ft, and does not contribute to the ground cloud or ground-level air pollution. Table 2.1-1 lists the exhaust products of SRM combustion and emissions quantities for current and proposed launch frequencies. It should be noted that Table 2.1-1 gives emission quantities based on complete SRM burn over 115 seconds, whereas only those products exhausted during the first few seconds contribute to the ground cloud (3). Of the exhaust products produced during Titan IV vehicle launch, hydrogen chloride (HCl), aluminum oxide (Al_2O_3), CO, and nitrogen oxides (NO_x) are recognized as air pollutants presenting potential hazards. The most significant of these combustion products, in terms of their potential for air quality degradation, are HCl and Al_2O_3.

Control devices will limit air emissions resulting from normal propellant loading and propellant-handling operations. The two propellants used are Aerozine 50 (50-percent 1,1-dimethyl hydrazine and 50-percent hydrazine) and nitrogen tetroxide (N_2O_4). A fuel vapor incinerator system (FVIS) will be installed to control vapors produced during the loading and

Table 2.1-1. SRM Combustion Products, Emissions per Launch, and Annual Emissions at Current and Proposed Launch Frequencies

Exhaust Product	Percent of Total Emission	Emissions per Launch (lb)	Annual Emissions (lb/yr)	
			Two launches/yr	Six launches/yr
H^+	0.02	237	473	1,420
C^-	0.22	2,603	5,207	15,621
CH^-	0.02	237	473	1,420
HCl*	20.55	243,185	486,371	1,459,112
H_2O	7.11	84,139	168,277	504,832
H_2	2.44	28,875	57,749	173,247
CO	27.75	328,389	656,778	1,970,334
CO_2*	2.48	29,348	58,696	176,088
N_2*	8.27	97,866	195,732	587,195
$AlCl_3$	0.89	10,532	21,064	63,193
Al_2O_3*	30.10	356,199	712,397	2,137,192
Other	0.15	1,775	3,550	10,650

*At altitudes less than 125,000 ft, it is expected that only HCl, CO_2, N_2, and Al_2O_3 will be detectable in significant quantities because of instability of molecular fragments and/or post-burning of the other materials in air of the lower atmosphere.

Note: $AlCl_3$ = aluminum chloride.
Al_2O_3 = aluminum oxide.
C^- = carbon anion.
CH^- = ionized hydrocarbon.
CO_2 = carbon dioxide
H^+ = hydrogen cation.
H_2 = hydrogen molecule.
H_2O = water.
lb = pounds.
lb/yr = pounds per year.

Sources: 4, 16.

handling of Aerozine 50, and an oxidizer vapor scrubber system (OVSS) will be installed to control vapors produced during the loading and handling of N_2O_4. Each of these systems was described in detail in the 1986 CELV EA.

Based on design specifications (8), the FVIS will remove 99.99 percent of influent hydrazine vapors. Therefore, hydrazine emissions to the atmosphere will be undetectable.

Design specifications (9) and extrapolation from testing at VAFB (17) indicate that the OVSS will convert at least 98.6 percent of the inlet N_2O_4 vapors to NO_x. Emissions of NO_x from the OVSS are projected to increase from about 0.12 ton per year (TPY) to 0.37 TPY as a result of the increase in the number of launches from two to six per year.

The emissions from both the FVIS and OVSS will occur over a period of less than 20 hours during each 20-day launch cycle. Therefore, by increasing the number of launches from two to six per year, the annual number of hours of emissions would increase from 40 to 120 hours.

Industrial operations related to the modified Titan IV program that could cause air pollutant emissions are spray painting and solvent cleaning within the expanded VIB. Applications for air pollution source permits covering these operations have been prepared and submitted to the Florida Department of Environmental Regulation (FDER), and permits have been issued. Spray application of heat-resistant coatings on payload fairings will be performed in the proposed VIB Annex. All spray applications will occur in two 25-ft by 70-ft spray booths. The processing of each payload fairing requires approximately 200 hours of spray booth operation. As shown in Fig. 2.1-1, each spray booth will be equipped with an exhaust/filter system. The filter system will limit emissions of particulate matter by approximately 95 percent. Paint vapors and

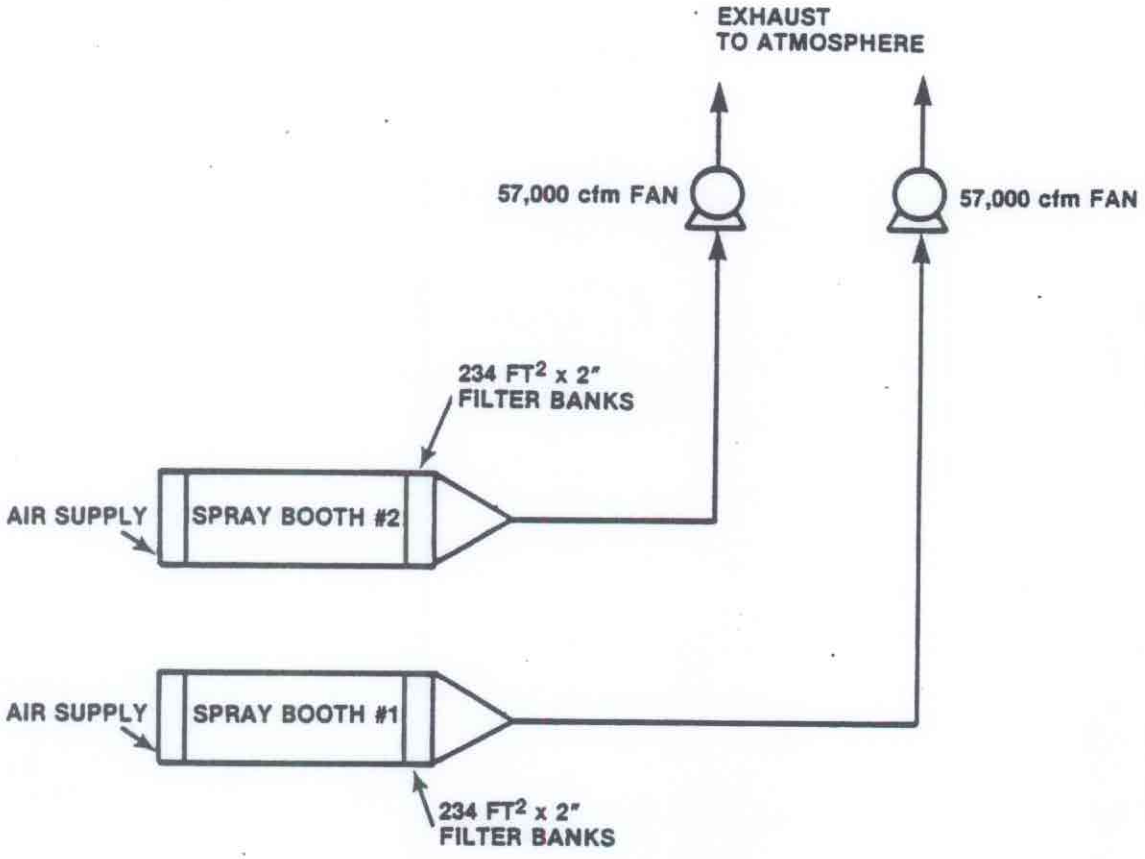

Figure 2.1-1
FLOW DIAGRAM, PAINT SPRAY BOOTHS NO. 1 AND NO. 2, VIB, CCAFB

SOURCE: 4.

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volatile organic compounds (VOCs) will also be emitted to the atmosphere by way of the exhaust system. VOCs which will be used in the spray booths are primer (primarily VM&P Naphtha), methylethyl ketone (MEK), and mineral spirits. Annual emission estimates for particulates and VOCs, based on six launches per year, are presented in Table 2.1-2.

Solvent-cleaning operations will also be performed in the proposed VIB Annex. Three solvent-cleaning tanks will dispense Freon 113 to be used for cleaning, wipedown, and preparation of small parts and tools. One exhaust hood and fan will capture vapors emitted from the solvent tanks, as shown in Fig. 2.1-2. Vapor emissions will be limited by removing excess and waste solvent from the tanks. Vapors released within the VIB will be vented to the atmosphere. Based on six launches per year, a maximum of about 5.4 TPY of Freon 113 will be emitted from the solvent-cleaning process. Freon 113 is not considered a VOC since it is not photoreactive and, therefore, does not act as an ozone precursor. No other VOCs will be used in the solvent-cleaning processes. FDER has issued permits for the solvent-cleaning operations.

Mobile diesel generators will be used to support the increased operations at Launch Complex 41. The projected schedule of generator use, based on six launches per year, is shown in Table 2.1-3. Based on the operating schedule in Table 2.1-3, annual emissions have been calculated using emission factors developed by the U.S. Environmental Protection Agency (USEPA) (18). Total annual emissions that will be produced by the backup mobile generators at Launch Complex 41 are given in Table 2.1-4.

2.1.1.3 Air Quality Impacts--

Impacts of emissions of HCl, Al_2O_3, CO, and PM from SRMs were analyzed for a single Titan launch event in the 1986 CELV EA. These analyses were based on diffusion models developed for the Titan III (3). When scaled to adjust for the increased propellant volume of the Titan IV, these

Table 2.1-2. Paint Spray Booth Emission Estimates*

Pollutant	Number of Payload Fairings/ Year	Emission Rates: Pounds per Hour	Emission Rates: Pounds per Payload Fairings	Total Annual Emissions (TPY)
Particulate Matter	6	3.7	733	2.2
VOCs				
Total VOCs	6	1.2	233	0.7
Primer+	6	0.8	166	0.5
Methylethyl Ketone	6	0.3	66	0.2
Mineral Spirits	6	<0.2	<33	<0.1

*Above estimates are totals for both spray booths based on six launches per year. Processing of each payload fairing requires approximately 200 hours of spray booth operation.
+Primarily VM&P Naphtha.

Note: TPY = tons per year.
VOCs = volatile organic compounds.

Source: 10.

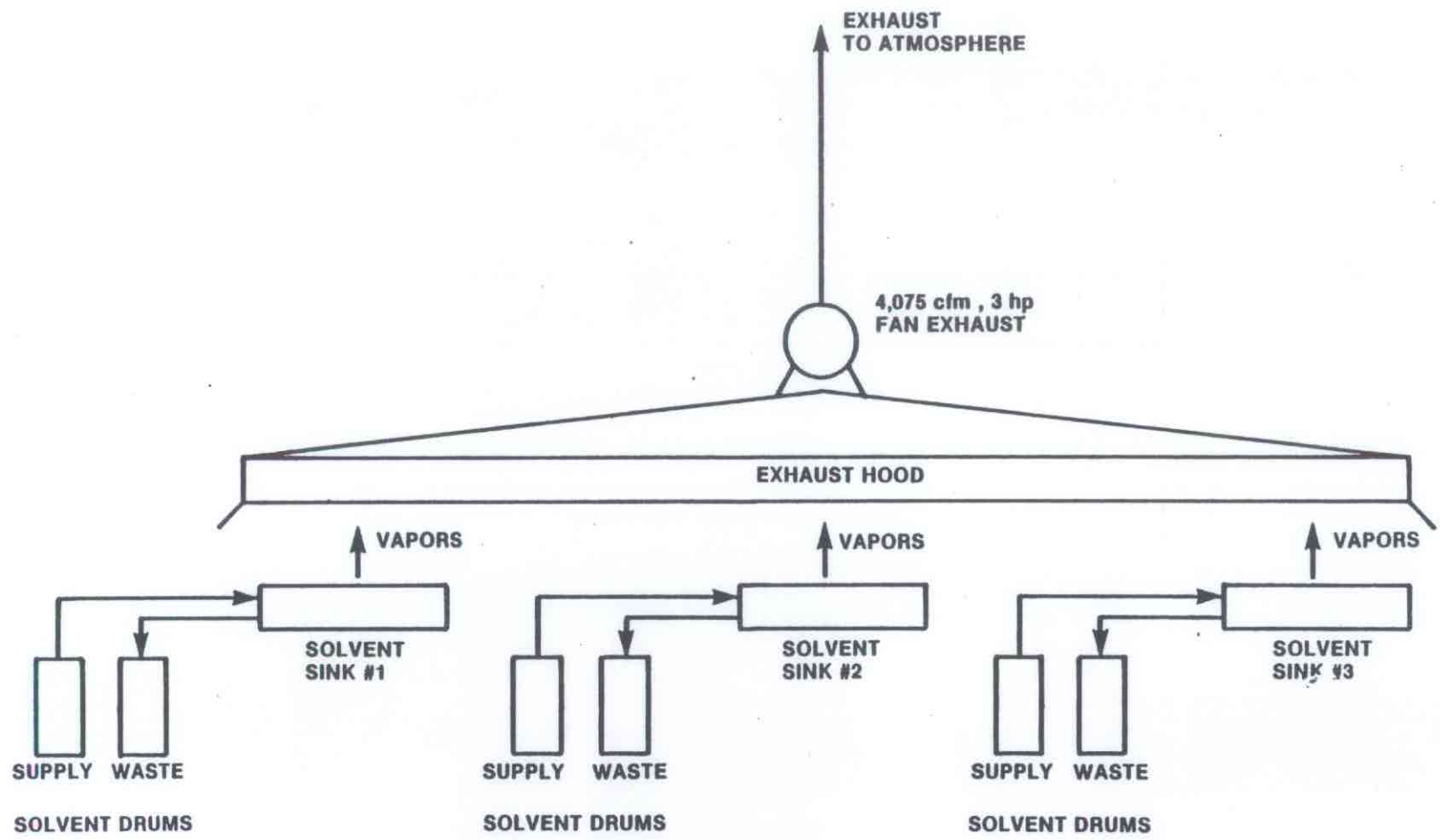

Figure 2.1-2
PROCESS FLOW DIAGRAM, SOLVENT SINKS (3), VIB, CCAFB

SOURCE: 4.

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Table 2.1-3. Projected Schedule of Generator Use

Generator Size (kW)	Number in Use	Days Per Launch Cycle	Days Per Year
2,000	1	30	180
350	2	10	60
50	10	2	12

Note: kW = kilowatt.

Source: 11.

Table 2.1-4. Total Projected Annual Emissions of Backup Mobile Generators at Launch Complex 41 Based on Six Launches per Year

Emission	Quantity	
	lb/hr	TPY
NO_x	105.7	161.8
CO	27.5	42.1
VOC	2.8	4.3
SO_2	12.0	18.3
PM	10.6	16.2

Note: lb/hr = pounds per hour.
TPY = tons per year.

Sources: 4, 18.

models predicted concentrations of contaminants occurring along a narrow path as the ground cloud moves downwind from the launch pad under typical weather conditions at CCAFB. Predicted concentrations represent peak ground-level values which are expected to occur over any given point for a short duration (minutes). The following discussion summarizes results presented in the 1986 CELV EA (3). It should be noted that few air quality standards apply to the short, intermittent space vehicle launch events. Air quality standards are referenced primarily to provide a relative basis for comparison with predicted values.

Results of diffusion analyses reported in the 1986 CELV EA indicate that HCl concentrations will not exceed the Occupational Safety and Health Administration (OSHA) permissible exposure limit of 5 parts per million (ppm) (8-hour time-weighted average) beyond 11 kilometers (km) (6.8 miles) from the launch site. These predictions are supported by field testing efforts which have not detected HCl at ground level at locations up to 22 km (13.5 miles) downwind of the Titan launch site (3).

Similar analyses projected that peak concentrations of Al_2O_3 will occur about 5 km (3 miles) from the launch site and will not exceed 38 milligrams per cubic meter (mg/m^3). The threshold limit value (TLV) for Al_2O_3 established by the American Conference of Governmental Industrial Hygienists (ACGIH) for an 8-hour day/40-hour week is 10 mg/m^3. This value should not be exceeded beyond approximately 14 km (8.7 miles) from the launch site (3).

Predictive modeling (3) indicates that CO concentrations will not exceed the NAAQS of 35 ppm (1-hour average) outside the launch complex boundaries. CO concentrations should be below the NAAQS 8-hour average of 9 ppm within about 14 km (8.7 miles) of the launch complex.

The NAAQS for PM is 150 micrograms per cubic meter (ug/m^3), calculated as a 24-hour average. Titan IV launches, because of their short duration, will not exceed this level (3).

The nearest uncontrolled area lies approximately 16 km (10 mi) from Launch Complex 41. At this distance, it is not expected that the general population will be exposed to deleterious concentrations of any air pollutants. Because of the short, infrequent nature of Titan IV launches and the limited impacts associated with individual launches, no significant reduction in air quality is expected to result from increasing the frequency of launches from two to six per year.

Air quality impacts from propellant-loading and propellant-handling operations will not be significant. Although hydrazine vapors are a hazardous pollutant, emissions will be reduced to nonhazardous levels by the FVIS. Emissions of NO_x from the OVSS will be measurable, but at such low levels that the NAAQS for NO_2 will not be exceeded. In addition to the control devices installed on the propellant systems, propellant operations will not be conducted during adverse weather conditions; therefore, even in the unlikely event of an accidental propellant spill, air impacts will be minimized. The ACGIH TLV for hydrazine is 0.1 ppm; the TLV for N_2O_4 is 3.0 ppm.

Range Safety monitors weather conditions prior to and during propellant handling, and specific weather conditions must be met to conduct these activities. The scheduled venting activity is regulated by Range Safety policy which requires the following specific atmospheric conditions to be satisfied prior to venting:

1. Three knot minimum wind velocity,
2. Negative temperature gradient (i.e., no temperature inversion), and
3. Wind direction not directed toward populated areas.

These weather parameters are measured at the launch site and then combined in a dispersion model to predict a plume corridor. The predicted plume must meet Range Safety requirements before scheduled venting occurs. Potential impacts during spill scenarios were described in the 1986 CELV EA. Air quality impacts from propellant operations will not be significantly increased by the proposed increase in launch frequency.

Significant air quality impacts will not result from industrial operations in the VIB Annex. Based on six launches per year, estimated particulate emissions will be approximately 2.2 TPY and total VOC emissions will be about 0.7 TPY. The types of VOCs to be used in the VIB all have TLVs, as established by ACGIH (1), well in excess of the concentrations that will result from the proposed operations.

Emissions associated with the operation of the backup mobile generators at Launch Complex 41 will not exceed any annual or short-term NAAQS.

In summary, no significant impacts to air quality are anticipated to result from launch, propellant operations, industrial processing, or electrical generation operations associated with the proposed Titan IV program modifications.

2.1.2 Geology

The geologic setting of CCAFB has been described in the 1986 CELV EA. The proposed modifications to the Titan IV program will have no geological effect.

2.1.3 Soils

The soils underlying CCAFB and Launch Complex 41 have been described in the 1986 CELV EA.

The proposed expansion of the VIB facility and associated infrastructure will require about 7,650 cubic yards (yd^3) of fill material. Fill material will be clean sand obtained from a CCAFB upland borrow area. The total area to be filled will be approximately 2.36 acres. No other alteration to soil characteristics of CCAFB will result from the proposed modifications to the Titan IV program.

2.1.4 Hydrology

2.1.4.1 Ground Water--

Hydrologic characteristics of ground waters on CCAFB have been described in the 1986 CELV EA.

The proposed increase in launch frequency will increase the quantity of water discharged to the ground water table at Launch Complex 41. Approximately 400,000 gallons (gal) of water are used during each launch event. This volume includes about 300,000 gal of deluge water used during the launch and about 100,000 gal of postlaunch washdown and fire-suppressant water. The overall annual volume of water to be used will increase from 800,000 gal for two launches to 2.4 million gallons (MG) for the projected six launches. Of the projected 2.4 MG for six launches, 1.8 MG will be used for deluge water, and 600,000 gal will be used for postlaunch washdown and fire-suppressant water. This compares with an annual use of 600,000 gal used for deluge water and 200,000 gal used for postlaunch washdown and fire-suppressant water under the current schedule of two launches per year. An estimated 20 percent of this water flows directly off the launch pad onto the surrounding area and percolates to the shallow unconfined aquifer. The remaining 80 percent is collected in the flame bucket located beneath the vehicle. The projected increase in launches from two to six per year will result in an increase in water flowing directly to grade from about 160,000 gal for two launches to about 480,000 gal for six launches annually. The

projected total annual volume of water collected in the flame bucket will increase from about 640,000 gal for two launches per year to about 1.92 MG for six launches per year. Current and anticipated discharges to ground water are presented in Table 2.1-5.

If the quality of water collected in the flame bucket meets applicable state and Federal criteria, this water will be discharged to grade and will percolate to the shallow unconfined aquifer. If water in the flame bucket is found to be contaminated, it will be collected and disposed of in accordance with state and Federal regulations. USAF has prepared and submitted an industrial wastewater permit application to FDER for the discharge to grade of deluge and fire-suppressant water. The industrial wastewater permit requirements are further discussed in Sec. 3.2.1 of this report.

Titan IV program modifications will result in minor staffing increases at Launch Complex 41 and the VIB. Minor increases in domestic wastewater loads will be associated with these personnel increases. Domestic wastewaters at Launch Complex 41 and the VIB are treated at onsite extended aeration sewage treatment plants (STPs). These STPs are permitted by FDER and discharge to infiltration systems which allow the treated wastewaters to percolate to ground waters. Based on projected personnel increases, wastewater loads at both Launch Complex 41 and the VIB will be well within STP design capacities.

Following discharge to grade, waters at Launch Complex 41 will percolate into the ground water table and flow west toward the Banana River. Waters discharged from the VIB wastewater facility will percolate to the ground water table and flow toward a tidal lagoon, which is connected via culvert to the Banana River.

Table 2.1-5. Project Launch-Related Discharges to Ground Water at Launch Complex 41

Source	Projected Discharge Volume (gal) for Two Launches Per Year	Projected Discharge Volume (gal) for Six Launches Per Year	Increase in Discharge Volume (gal)
Deluge Water	600,000	1,800,000	1,200,000
Fire Suppressant/ Washdown	200,000	600,000	400,000

Source: 4.

Volumes of water associated with the proposed Titan IV program modifications are relatively small and, to a large extent, episodic. No significant impacts to ground water hydrology will result from the proposed modifications.

2.1.4.2 Surface Water--

Surface water resources in the vicinity of CCAFB and Launch Complex 41 are described in the 1986 CELV EA. Water associated with launch events which is discharged to grade will percolate into the sandy soils and will not drain directly to surface waters. Based on observations from Launch Complex 40, the discharged flame bucket water is expected to percolate into the ground and not flow directly to adjacent surface waters. The rate of discharge from the flame bucket will be adjusted to ensure that surface flow offsite does not occur.

Stormwater runoff from impervious areas associated with VIB expansion will be managed in accordance with a permit issued by the St. Johns River Water Management District (SJRWMD) and will not impact surface water hydrology. Significant impacts to surface water hydrology will not result from the proposed modifications to the Titan IV program.

2.1.5 Water Quality

2.1.5.1 Ground Water--

The water quality characteristics of ground water on CCAFB have been described in the 1986 CELV EA.

Potential sources of ground water contamination associated with the proposed increase in launch frequency and associated support facility modifications include:

1. Increased volumes of water used at Launch Complex 41 during launch events and for postlaunch washdown,

2. Increased discharge of nonindustrial sanitary wastewater from onsite package STPs at Launch Complex 41 and the VIB, and
3. Increased stormwater runoff from additional impervious areas at the VIB facility.

These concerns are addressed in the following paragraphs.

As detailed in the 1986 CELV EA, no significant ground water quality impacts are expected to result from launch-associated operations. All water used as deluge and fire-suppressant water and for postlaunch washdown is potable water supplied from municipal sources. The only potential contaminants used on the launch pad are fuel and oxidizer. Any accidental release of these substances would be expected to occur over the flame bucket and would not contaminate the launch pad surface or launch pad runoff. The USAF has an Oil and Hazardous Substance Pollution Contingency Plan (OPLAN 19-1) which establishes response actions to be taken in the event of such accidental releases. Under this plan, such releases are rapidly contained, immediately cleaned up, and managed in accordance with applicable Federal and state regulations.

Water collected in the flame bucket will be retained and analyzed to ensure that it meets all applicable state and Federal water quality criteria before being discharged to grade. If the flame bucket water is found to be contaminated, it will be managed in accordance with state and Federal regulations and the CCAFB Hazardous Waste Management Plan (OPLAN 19-14).

Only minor increases in sanitary wastewater volume will result from the proposed Titan IV program modifications. The STPs at Launch Complex 41 and the VIB facility have design capacities well in excess of anticipated loads. These STPs will provide for adequate waste treatment and will not cause significant ground water quality degradation. The STP at Launch Complex 41 has a capacity of 13,000 gallons per day (gpd) and currently

anticipated due to the increase from two to six launches per year. The increase in launches per year will not result in a significant increase in the daily loading rate of the STP. The STP will provide adequate waste disposal capacity under the modified schedule.

The STP at the VIB facility has a capacity of 38,000 gpd and currently is operating at approximately 1,500 gpd. The STP at the VIB facility also will provide adequate waste-disposal capacity under the modified schedule.

Impervious areas at the VIB facility will increase by approximately 1.58 acres as a result of VIB expansion and the paving of additional areas for roads and parking. This increase in impervious area will increase the projected peak stormwater runoff rate from 4.0 to 9.2 cubic feet per second (cfs) and increase the projected volume runoff of stormwater runoff from 0.5 to 1.2 acre-feet under conditions of the 25-year, 24-hour design storm.

Stormwater runoff will be collected in a swale system and retained in a basin located west of the VIB extension. Most of the water collected in this system will infiltrate into the ground water table. This stormwater system has been approved by the State of Florida and will not result in the significant degradation of ground water or surface water quality.

2.1.5.2 Surface Water--

The quality of surface waters of CCAFB and the Banana River has been described in the 1986 CELV EA.

Impacts to surface waters which will, or could potentially, result from the proposed Titan IV program modifications include:

1. An increase in the number of normal flights, which will result in the disposal of additional spent suborbital stages in the ocean;
2. In-flight failures, which may result in vehicle hardware and propellants falling into the ocean or nearby surface waters;
3. On-pad accidents and accidental propellant spills, which may result in the runoff of propellants to local drainage systems;
4. Contamination of surface waters from exhaust cloud deposition of HCl and Al_2O_3; and
5. Surface water impacts associated with the VIB expansion and placement of fill material.

The impacts of Items 1 through 4 above are identical to those described for the CELV program in the 1986 EA. However, the increased launch frequency will increase either the magnitude of these impacts or their potential for occurrence. These impacts and potential impacts are discussed in the following paragraphs.

Under normal flight conditions, vehicle stages that do not go into orbit have trajectories which result in ocean impact. Stages that reach initial orbit will reenter the atmosphere as a result of orbital decay and will also enter the ocean. Reentry trajectories for various spent stages are slightly different but all are programmed to impact in the open ocean, far from coastal areas. A detailed discussion of the flight trajectory of the CELV is presented in the 1986 CELV EA. Corrosion of stage hardware will contribute various metal ions to the water column. Because of the slow rate of corrosion in the marine environment and the large quantity of water available for dilution, toxic concentrations of metals are not likely to occur. No significant impacts to ocean water quality are expected to result from the proposed increase in launch frequency.

Relatively small amounts of propellant may also be released into the ocean along with the various spent stages. SRMs may contain small quantities of ammonium perchlorate mixed in a rubbery binder. Release to the water column will be slow, with toxic concentrations occurring only in the immediate vicinity of the propellant, if they occur at all. Both Aerozine 50 and N_2O_4 may be present in small quantities in spent liquid fuel stages, and small amounts of these water-soluble propellants may be expected to enter the ocean as the result of normal flight. Concentrations in excess of the maximum acceptable concentration (MAC) of these compounds for marine organisms will be limited to the immediate vicinity of the spent stages (16). Because of the small amount of residual propellants present and the large volume of water available for dilution, no significant impacts to ocean systems will be caused by the reentry of spent stages.

The possibility exists of an inflight termination and the activation of the vehicle destruct system. Under such conditions, the liquid propellant tanks are ruptured and the propellants dispersed. Because of the hypergolic (igniting upon contact without external aid) nature of Aerozine 50 and N_2O_4, the propellants will ignite and burn. The completeness of this burn is not known, however, and there is a possibility that liquid propellant will enter the water. Under most conditions, because of the availability of the emergency destruct system which has never failed, the amount of unburned propellant reaching surface waters will be significantly less than the entire liquid fuel load. In addition, the amount of liquid propellant released will depend on the time of flight. In the event of inflight termination, MACs for Aerozine 50 and N_2O_4 may be temporarily exceeded in a localized area.

As a worst-case situation, it is possible that the vehicle may be terminated only a few seconds after liftoff, resulting in nearly the entire quantity of liquid propellant being released into the ocean or

nearby surface waters. In the event of the near-shore or near-pad impact of a vehicle following termination, water quality may be significantly impacted. The area in which water quality impacts occur will depend on the amount of propellant released, the depth and mixing characteristics of the water column, and ambient water quality characteristics. For this worst-case situation to occur, an early-flight failure of the Titan IV vehicle and failure of the vehicle destruct system (never observed) would have to occur. It is highly unlikely that, even with the proposed increase in launch frequency, these events will ever occur simultaneously.

Accidental releases of small quantities of propellants may occur as a result of the Titan IV program at Launch Complex 41. All propellant spills will be retained in the impervious holding areas surrounding the propellant supply tanks or in the flame bucket located immediately beneath the launch vehicle. Spilled propellants will be removed from these areas and disposed at an appropriate hazardous waste facility offsite. Accidental spills of propellants will not significantly impact surface water quality around Launch Complex 41.

Surface water quality impacts may also result from the interaction between the exhaust cloud produced by the Titan IV SRMs and area surface waters. The primary products of SRM combustion with the potential to impact surface water quality are HCl and Al_2O_3. The impact of these exhaust products on surface water quality will be dependent upon the composition and character of the exhaust cloud, duration of contact with the water, wind speed and direction, and ambient atmospheric conditions. Because of the rapid ascent of the Titan IV off the launch pad, only the exhaust from the first few seconds of the SRM burn will be in the ground cloud (16). The cloud will move downwind of the launch complex and will be over any single location for only several minutes prior to dispersal.

The primary concern associated with the exhaust cloud impacts on water quality is the formation of HCl. Short-term acidification of surface water may result from direct contact with the exhaust cloud, through deposition of HCl in the form of dryfall, and through the deposition of HCl in wet precipitation. Because of atmospheric diffusion of the exhaust cloud, impacts to surface waters will likely be restricted to areas adjacent to Launch Complex 41. Titan IV program constraints do not allow for launch when rain is occurring or is likely to occur. A worst-case scenario would involve an unforeseen rainstorm intersecting the ground cloud shortly after launch near Launch Complex 41. Under such conditions, it has been estimated that rains with a pH of 1.5 could occur near the launch site (14). The average pH of rainfall in the CCAFB vicinity is 4.7 (13). Due to the extensive bicarbonate buffering capacity of the Atlantic Ocean and the Banana River, any acidification would be of short duration and probably restricted to shallow waters in the immediate path of the ground cloud. The freshwaters associated with the drainage system on CCAFB have a lower buffering capacity and would be more susceptible to short-term acidification.

Al_2O_3 will also be present in relatively large quantities in the exhaust cloud from the Titan IV vehicle SRMs. Deposition of Al_2O_3 in surface waters will depend on wind direction and speed. It is possible that Al_2O_3 could be deposited in the Banana River and adjacent marsh areas as a result of easterly winds during vehicle launch, or in the Atlantic Ocean if westerly winds prevail. Deposition of Al_2O_3 in surface waters and marshes will be limited by diffusion of the exhaust cloud in the atmosphere and the distance of Launch Complex 41 to the Banana River (3,000 ft). Al_2O_3 will be relatively insoluble at the ambient pH of the Banana River and the Atlantic Ocean. Tidal flushing in the marsh areas and oceanic currents will prevent accumulation of significant quantities of Al_2O_3.

Deposition of HCl and Al_2O_3 from the Titan IV vehicle exhaust clouds will not significantly impact surface water quality around Launch Complex 41. Because of the relative infrequency of launch events and the minor potential for launch-related impacts, no significant adverse impacts to surface waters should result from the proposed increase in Titan IV launch frequency.

The expansion of the VIB and associated parking and driveway areas will not result in significant impacts to surface water quality. The VIB is located on a man-made island and lies adjacent to an interim lagoon, connected by culvert to the Banana River. Fill activities have been conducted to prepare the 2.36-acre site and to bring the site up to construction grade using clean sand. The source of this sand is an inland borrow pit located on CCAFB. These activities were permitted by FDER and the U.S. Army Corps of Engineers (COE) and employed turbidity screens to minimize the potential for construction-related impacts on surface water quality. Given the clean fill, small area of filling, specific runoff controls, and limited connection of the VIB lagoon to the Banana River via a culvert served to eliminate water-quality impacts.

Following construction, drainage from the VIB and associated infrastructure areas will be collected in a grassed swale system leading to a retention pond. Discharge from this system will flow with the adjacent man-made lagoon. This stormwater system will retain runoff generated by the first inch of rainfall in accordance with SJRWMD Stormwater Discharge Permit requirements. Water discharging from this system will not significantly impact surface water quality in the lagoon or the Banana River.

2.1.6 Biota

CCAFB is located in east-central Florida on the Cape Canaveral Peninsula. Ecological resources on the station are influenced by the Atlantic Ocean

on the east and the Banana River on the west. Vegetation communities and related wildlife habitats are representative of barrier island resources of the region. Major communities at CCAFB include beach, coastal strand and dunes, coastal scrub, lagoons, brackish marsh, and freshwater systems in the form of canals and borrow pits.

The restrictive nature of CCAFB and KSC activities has allowed large areas of land to remain relatively undisturbed. Of 15,438 acres on CCAFB, 11,977 acres has remained or reverted back to natural conditions. In addition to communities found at CCAFB, coastal hammocks and pine flatwoods are found on KSC to the northwest and increase the ecological diversity and richness of the area.

The terrestrial and aquatic biological resources of CCAFB and its surrounding area have been detailed in the 1986 CELV EA. A brief description of the environmental settings of the facilities affected by proposed Titan IV program modifications is given below.

Launch Complex 41 is located near the northern boundary of CCAFB. This complex lies within the coastal strand community. Coastal strand communities exhibit low profiles which are maintained by nearly constant winds and salt spray. These communities exist on sandy, excessively drained soils dominated by shrubs and are often nearly devoid of ground cover vegetation. Plants that characterize the coastal strand community on CCAFB include saw palmetto (Serenoa repens), wax myrtle (Myrica cerifera), tough buckthorn (Bumelia tenax), cabbage palm (Sabal palmetto), partridge pea (Cassia fasciculata), and prickly pear (Opuntia spp.).

The VIB is located on an island in the Banana River which has been largely created by dredged materials, primarily well-drained sands. Most unimproved upland portions of this island are covered by low, sparse

grasses. Wetland vegetation surrounds the island and borders an interior lagoon which is connected via culvert to the Banana River. Vegetation which occurs in the vicinity of the VIB includes wax myrtle, groundsel-bush (Baccharis halimifolia), willow (Salix caroliniana), Brazilian pepper (Schinus terebinthefolius), sawgrass (Cladium jamaicense), and a variety of forbs and grasses.

Wildlife species which are characteristic of the vegetative communities found on CCAFB are given in Appendix A.

2.1.6.1 Impacts to Terrestrial Biota--

The proposed Titan IV program modifications are not expected to significantly impact terrestrial and wetland biota on CCAFB. All proposed activities at Launch Complex 41 will be conducted within the existing launch complex boundary and will not result in the loss of any additional habitat. Wildlife in the vicinity of Launch Complex 41 have adapted to disturbances associated with normal operations and launch events. Elevated noise levels associated with increased launch frequency will not significantly affect wildlife populations on CCAFB.

Construction of the VIB Annex and associated roadways and parking areas will require the filling of approximately 2.36 acres, including 0.34 acre of wetland. This wetland is associated with the man-made lagoon located to the west of the VIB and is dominated by sawgrass. The upland edge of this wetland is bordered by a shrub thicket which is comprised primarily of wax myrtle, groundsel-bush, and Brazilian pepper. The rest of the upland area that will be developed is a mowed area dominated by sparse forbs and grasses.

The proposed construction of the VIB Annex and associated infrastructure will not result in the significant loss of wetlands or other areas critical to the support of wildlife resources. A dredge-and-fill permit

has been obtained from FDER and the COE prior to the filling of any wetland area.

Local wildlife will not be exposed to hazardous or toxic chemicals as a result of proposed activities at Launch Complex 41. Containment provisions at the launch site will prevent spilled propellants or contaminated water from being released to the surrounding environment. Wildlife in the direct path of ground-level exhaust clouds may experience short-term elevated levels of nuisance dust, primarily Al_2O_3, and elevated levels of HCl. Studies of Titan IIIC launches at CCAFB have not detected HCl within ground clouds in toxic concentrations (16). Periods of exposure to dust and HCl will be limited because the exhaust cloud will be subject to prevailing winds and dispersion and, even during calm wind conditions, will remain over any single point a relatively short period of time. Overall, exhaust clouds associated with the Titan IV program will not result in significant impacts to wildlife.

Minor impacts to vegetation may occur as a result of HCl deposition. These impacts will be short term and primarily restricted to the immediate vicinity of Launch Complex 41. The magnitude of these impacts may increase slightly as a result of the proposed increase in launch frequency.

2.1.6.2 Impacts to Aquatic Biota--

Impacts to aquatic biota which will, or could possibly, result from operational elements of the Titan IV program include:

1. Impacts of spent stages and jettisoned hardware on oceanic organisms as a result of normal flight;
2. In-flight failures, which may introduce propellants and vehicle hardware to aquatic systems;
3. Contamination of water by the exhaust cloud; and
4. Introduction of fill material for the VIB parking lot expansion.

The proposed Titan IV program modifications will result in an increased launch frequency and will result in an increase either in the magnitude of these impacts or their potential for occurrence. These impacts and potential impacts are discussed in the following paragraphs.

Under normal flight conditions, vehicle stages that do not go into orbit have trajectories which result in ocean impact. Stages that reach initial orbit will reenter the atmosphere as a result of orbital decay. Reentry trajectories for various spent stages are slightly different but all are programmed to impact in the open ocean, far from coastal areas. Corrosion of stage hardware will contribute various metal ions to the water column. Because of the slow rate of corrosion in the deep ocean environment and the large quantity of water available for dilution, toxic concentrations of metals are not likely to occur.

Relatively small amounts of propellant may also be released into the ocean along with the various spent stages. SRMs may contain small quantities of ammonium perchlorate mixed in a rubbery binder. Release to the water column will be slow, with toxic concentrations occurring only in the immediate vicinity of the propellant, if they occur at all (16). Both Aerozine 50 and N_2O_4 are soluble in water and may be present in small quantities in spent liquid fuel stages. Concentrations in excess of the MAC for these compounds for marine organisms will be limited to the immediate vicinity of the spent stage. Because of the small amount of residual propellants present and the large volume of water available for dilution, no significant impacts are expected to be caused by the reentry of spent stages.

The potential exists for an early inflight termination and activation of the vehicle destruct system. Due to the hypergolic nature of Aerozine 50 and N_2O_4, the majority of the propellants will ignite and burn. Since

the completeness of this burn is not known, there is a possibility that liquid propellant may enter the water with localized impacts to the aquatic biota as a result of the MAC being exceeded. A worst-case failure would involve not only a near-pad failure of the Titan vehicle but also the simultaneous failure of the vehicle destruct system, which has never been observed. Under such worst-case conditions, water quality and aquatic biota may be locally impacted for a short period of time, with the degree of impact dependent on the amount of propellant released, the depth and mixing characteristics of the water column, ambient water quality characteristics, and the nature of the impacted community.

MACs of a pollutant in water are those which have little or no lasting effect on the biota being considered (16). Several studies have been conducted to determine MACs of propellants on freshwater and marine biota (5,6,12). While a limited number of species were tested in these studies, they serve to provide a basis for estimating propellant toxicity. Based on these estimates and a dispersion model used in the Final Environmental Statement for the United States Air Force Space Launch Vehicles (16), in waters over 10 ft deep the radius of the contaminated area in which MACs are exceeded could vary from approximately 800 to 8,000 ft, depending on the fraction of the propellant released.

Potential impacts to aquatic biota may result from the interaction of the ground-level exhaust cloud with surface water. The primary products of combustion which may affect water quality and aquatic biota are HCl and Al_2O_3. The impact of the exhaust cloud on aquatic biota will be a function of the composition of the exhaust cloud, duration of contact with the water, wind speed and direction, and ambient atmospheric conditions.

Potential impacts to aquatic biota may result from the acidification of surface waters by HCl in ground clouds. Under normal conditions of diffusion and wind transport, ground clouds will remain for only a short period of time over any given location and HCl deposition rates will be low. Higher deposition rates would occur if HCl were washed out of the ground cloud by precipitation. However, Titan IV program operational constraints do not allow for launches during rain or heavy cloud cover. These operational constraints are determined by Range Safety prior to and during each launch. Range Safety is tasked to provide the necessary qualified personnel, facilities, and data needed to evaluate the Launch Minima as delineated in the launch test directives (LTDs). The Launch Minima require the following observations to be made from 30 minutes prior to launch up to the time of launch and reported to the Titan IV Launch Coordinator:

1. Cloud type, cloud dimensions, and temperature levels in the cloud for clouds within 10 nautical miles of the launch site and within ten 10 nautical miles of the vehicle flight path.
2. Ambient air tempreature at the launch pad (for 24-hour period prior to launch).
3. Rainfall rate of 0.1 inch/hour or greater.
4. Lightning activity within 10 nautical miles of the launch pad.
5. Triggered lightning constraints are TBD.

As a result, the potential for localized HCl washout is minimal. It should also be noted that the high buffering capacity of the Atlantic Ocean and Banana River will rapidly neutralize excess acidity. Under normal operating conditions, no significant impacts to aquatic biota are expected to result from the acidification of surface waters by ground clouds.

Given a worst-case scenario wherein an unforeseen rainstorm intersects the Titan IV ground cloud in the vicinity of the launch complex,

modification could adversely impact aquatic biota. As previously noted, the buffering capacity of saline waters in the vicinity will rapidly neutralize acidity and should limit the extent and duration of any impacts. Impacts to freshwater biota associated with the surface water drainage system in the launch site vicinity could be more severe but would also be expected to be temporary. No other freshwater resources occur in the immediate vicinity of Launch Complex 41.

Deposition of Al_2O_3 from the exhaust cloud may occur over surface waters, depending on wind speed and direction during vehicle launch. Because of the relatively rapid dispersion of the exhaust cloud, deposition of large quantities of Al_2O_3 is not expected to occur in adjacent surface waters. Al_2O_3 entering the aquatic environment as a result of Titan IV launch activities will likely remain insoluble in the ambient pH range of the Atlantic Ocean and Banana River (8.0 to 8.5). Furthermore, in this pH range aluminum is nontoxic to most aquatic organisms.

Overall, no significant long-term adverse impacts to aquatic biota are expected to occur as a result of the ground-level exhaust clouds generated by proposed operations at Launch Complex 41.

A small amount of fill (1,044 yd^3) will be placed waterward of the ordinary high-water line as part of the VIB modifications. The fill will consist of clean sand from an onsite borrow area and will be placed within a diked portion of the Banana River adjacent to the VIB. A total of 0.34 acre will be filled waterward of the ordinary high-water line. This area primarily consists of wetland vegetation. Due to the restricted extent of the area to be filled, no significant adverse impacts to aquatic biota are anticipated as a result of filling activities associated with VIB modifications. Dredge-and-fill permits for the VIB facility expansion have been received from FDER and COE.

2.1.6.3 Impacts to Endangered and Threatened Species--
The 1986 CELV EA identifies wildlife species listed as endangered or threatened by the Federal Endangered Species Act of 1973 (as amended) and the Florida Endangered and Threatened Species Act of 1977 (as amended). These species and their status are listed in Table 2.1-6.

No adverse impacts are anticipated on endangered or threatened species residing on CCAFB and adjoining waters from the proposed modifications to the Titan IV program. High noise levels from Titan IV launches will occur only six times a year and are temporary. With the exception of the additional potential for small brush fires in the vicinity of the launch complex, no significant destruction or permanent adverse impacts on the surrounding scrub habitat is expected to occur. The Air Force, as well as the staff of the nearby Merritt Island National Wildlife Refuge, has standby fire-fighting equipment to control such fires.

Construction and operation of the VIB Annex is not expected to cause adverse impacts on endangered and threatened species. A small portion of the man-made lagoon located adjacent to the VIB is proposed to be filled. This lagoon is connected by culvert to the Banana River. Manatees cannot enter the lagoon and will not be impacted by the proposed construction of the VIB annex.

2.2 MAN-MADE ENVIRONMENT

2.2.1 Population

2.2.1.1 Demography--
The demographic composition of Brevard County is described in the 1986 CELV EA.

Operational personnel associated with the proposed Titan IV program modifications will be drawn primarily from the current employment pool at CCAFB. Any additional personnel which may be required are expected to be

Table 2.1-6. Endangered and Threatened Species Residing or Seasonally Occurring on CCAFB and Adjoining Waters

Species	Status	
	USFWS	FGFWFC
Mammals		
West Indian manatee (*Trichechus manatus*)	E	E
Birds		
Wood stork (*Mycteria americana*)	E	E
Bald eagle (*Haliaeetus leucocephalus*)	E	T
Peregrine falcon (*Falco peregrinus*)	T	E
Southeastern kestrel (*Falco sparverius*)	--	T
Red-cockaded woodpecker (*Picoides borealis*)	E	T
Florida scrub jay (*Aphelocoma coerulescens*)	--	T
Reptiles		
Green turtle (*Chelonia mydas*)	E	E
Kemp's ridley turtle (*Lepidochelys kempii*)	E	E
Loggerhead turtle (*Caretta caretta*)	T	T
Eastern indigo snake (*Drymarchon corais*)	T	T

Note: USFWS = U.S. Fish and Wildlife Service.
FGFWFC = Florida Game and Fresh Water Fish Commission.
E = endangered.
T = threatened.
-- = not listed.

Source: 4.

available in the existing labor force of Brevard County and neighboring areas. No significant influx of personnel into the area will result from the proposed action, and there will be no substantial demographic effects.

2.2.1.2 Housing--

Few additional personnel will be required to support the proposed program modifications. Because additional personnel will be drawn from the existing labor force of CCAFB and Brevard County, no effects on housing in the area will result from the proposed action.

2.2.2 Socioeconomics

2.2.2.1 Land Use Compatibility--

CCAFB has been developed to provide launch, tracking, and other facilities in support of DOD, National Aeronautics and Space Administration (NASA), and other range-user programs. Approximately 30 percent of the base is developed and consists of launch complexes and support facilities. The remaining 70 percent consists of unimproved lands.

The proposed Titan IV program modifications are compatible with current and projected future land uses on CCAFB.

2.2.2.2 Community Facilities and Services--

Community facilities and services on CCAFB and in Brevard County are detailed and described in the 1986 CELV EA. Existing facilities and services are adequate to support the Titan IV program and proposed program modifications. The proposed actions will not significantly affect community facilities and services.

2.2.2.3 Economy--

The majority of the personnel employed in support of the proposed operations are on the current payrolls of Martin-Marietta, CCAFB, or KSC. The proposed Titan IV program modifications will not have a significant impact on the local economy.

2.2.3 Noise Pollution

The impacts of noise generated by rocket engines and launch vehicles, including sonic booms, were evaluated in detail in the 1986 CELV EA. As described, the short, intermittent nature of launches and the distances to uncontrolled areas will prevent launch-generated noise from creating adverse impacts. Increasing the annual number of launches from two to six does not alter these conclusions.

2.2.4 Archaeological and Cultural Resources

Facility expansions required for the proposed Titan IV program modifications are minor and will occur on previously disturbed lands. No additional area will be disturbed in the vicinity of Launch Complex 41. Expansion of the VIB facility will occur on lands previously created or altered by dredge-and-fill activities. Because no undisturbed lands will be affected by the proposed actions, no impacts to archaeological or cultural resources will occur.

3.0 REGULATORY REVIEW

3.1 AIR QUALITY

Regulatory requirements related to launch vehicle exhaust and fueling operations were addressed in the 1986 CELV EA. To summarize, emissions from launch vehicle exhaust and mobile electric generators are exempt from FDER permitting, but emissions from fueling operations are not. Permit applications for the FVIS and OVSS fuel-loading controls have been submitted to FDER.

Emissions from spray painting and solvent cleaning are also subject to FDER permit reviews. Permit applications for these processes also have been submitted, and the permits have been issued.

3.2 WATER QUALITY

3.2.1 Industrial Wastewater Discharge

Increasing the number of vehicle launches from two to six per year will triple the annual volume of deluge, fire-suppressant, and washdown wastewaters. In order to meet applicable regulations, an industrial wastewater permit application is being prepared by USAF for submittal to FDER to bring the proposed operations into compliance. A full discussion of regulatory requirements is presented in the 1986 CELV EA.

There are no industrial wastewater discharge permit requirements for expansion of the VIB building or installation of additional backup mobile generation units at Launch Complex 41.

3.2.2 Stormwater Drainage

A Stormwater Discharge permit has been issued by SJRWMD for the swale and pond system designed to serve the VIB Annex and associated parking and driveway areas. This Stormwater Discharge permit (Permit No. 42-009-0153NG) was issued to USAF on 20 February 1987.

3.2.3 Surface Water Management

The discussion of regulatory requirements in the 1986 CELV EA is applicable to the increased number of launches and expansion of the VIB building. No surface water management permits are required.

3.2.4 Sanitary Wastewater Discharge

Sanitary wastes are currently treated at Launch Complex 41 by an extended aeration package STP, which has a design capacity of 13,000 gpd. The plant is currently operating at about 2,000 gpd. The plant is operating under FDER Permit No. DO05-121380, issued 14 July 1986.

The activities associated with increasing the number of vehicle launches from two to six per year, the expansion of VIB building, and installation of additional backup mobile generation units at Launch Complex 41 are not expected to result in a significant increase in sanitary wastewater discharge. The current plant flow is well below design capacity, and no modification of the plant permit is required by the anticipated flow increase.

The facility design criteria for the VIB Annex indicated that water and sewer lines are to be rerouted and an existing 10-inch water main is to be tapped to supply the VIB Annex. For the water main tap relocation, FDER requires submittal of a letter of explanation along with a set of plans indicating the proposed modifications and the location of existing and proposed water meters. For the sewer line relocation, FDER requires the Engineer-of-Record to submit a letter of explanation and as-built plans after construction has been completed. The letter should indicate which plant is receiving the discharge, the estimated total flow to the plant, and the incremental increase in flow, if any, due to the modifications at the VIB Annex.

3.3 HAZARDOUS WASTES

The discussion of hazardous waste management in the 1986 CELV EA is applicable to wastes generated by the increased number of launches and

the industrial operations to be conducted in the VIB Annex. The annual quantity of chemicals to be used and disposed by the increase of four launches per year is presented in Table 3.3-1. Hazardous wastes generated at Complex 41 and the VIB will be kept onsite in designated holding areas and shipped offsite within 90 days. All hazardous wastes generated will be managed in accordance with OPLAN 19-14 (Hazardous Waste Management Plan).

3.4 SPILL PREVENTION

The discussion of the spill prevention requirements in the 1986 CELV EA is applicable. CCAFB currently operates under OPLAN 19-1 in accordance with USEPA's Oil Pollution Prevention Regulation (19). No new storage tanks requiring secondary containment will be associated with the VIB annex. During a launch, temporary generators and associated fuel-storage tanks will be supplied to Launch Complex 41 by the USAF. One or two mobile fuel-storage tanks with a capacity of 300 gal each will be placed on concrete pads in the launch complex. Because these tanks will be in a facility with a single tank larger than 600 gal, secondary containment storage should be provided.

3.5 COASTAL MANAGEMENT PROGRAM

The discussion of the coastal management program in the 1986 CELV EA is applicable. CCAFB is exempt from the State of Florida Coastal Management Plan (CMP). However, on the basis of compatible land use, absence of significant environmental impact, and compliance with applicable regulations, the Titan IV program and proposed program modifications are consistent to the "maximum extent practicable" with the goals and objectives of Florida's CMP as required by the Federal Coastal Zone Management Act of 1972 (as amended).

3.6 ENDANGERED SPECIES

The status of endangered and threatened species onsite is addressed in the 1986 CELV EA. The proposed Titan IV program modifications are not expected to impact these species or their habitats.

Table 3.3-1. Chemical Wastes to be Used and Disposed by Titan IV Operations Based on Four Additional Launches per Year

Chemicals	Quantity Used Per Year	Quantity Disposed per Year
Solvent, Class B, Freon TF 113	1,600 gal	1,000 gal
Silicone Insulation Coating (Flamemaster) (14.4 II Kits)	2,800 lb	600 lb
Treating Agent, PA-2	28 gal	0
Dispersion Coating (SWS 90 Clear, SWS Silicones Corp.)	4 ounces	0
Iridite 14-2	1 gal	0
White Silicone Seal Coating	42 gal	0
Silver-Filled Coating (Plessey 3060-03)	20.2 gal	0
Primer, Clear (Dow Corning RTV 1200)	112 gal	0
Methylethyl ketone	30 gal	8 gal
Mineral Spirits	2 gal	2 gal
Methyl Alcohol	55 gal	50 gal
Isopropyl Alcohol MIL-A-10428A	900 gal	850 gal
Nitric Acid Sodium Dichromate Deoxidizer Acid (K807D600 and K807E600)	150 gal	150 gal
Alkaline Cleaner (K866E200)	75 gal	75 gal
Isoprep 177	75 gal	75 gal
Trichloroethane	20 gal	20 gal

Source: 10.

3.7 DREDGE AND FILL

Dredge-and-fill permits have been issued to USAF for site preparation activities required for the VIB Annex and associated infrastructure. These activities included the filling of 0.34 acre of wetland fringing the man-made lagoon located adjacent to the VIB site. A dredge-and-fill permit was issued by FDER (Permit No. 05-130856-4) on 22 April 1987, and a companion dredge-and-fill permit was issued by the COE (Permit No. 87ITK-20165) on 26 May 1987. No dredge-and-fill permits are required for modification at Launch Complex 41.

4.0 MITIGATION

4.1 AIR QUALITY

As described in the 1986 CELV EA, emissions resulting from launch operations will be controlled to the extent possible. Emissions associated with normal propellant-loading and propellant-handling operations will be controlled by the FVIS and OVSS vapor control systems. Particulate emissions from the spray-painting operation will be controlled by an exhaust/filter system (see Sec. 2.1.2.2). Emissions of VOCs from spray painting and solvent cleaning are at low enough levels that no add-on controls are economically justified. Emissions of Freon 113 from solvent cleaning will be limited by the removal of excess and waste solvent from solvent sinks.

4.2 SOILS

Proposed Titan IV program modifications will have minimal impacts on soils, and no mitigative measures are required.

4.3 WATER QUALITY

4.3.1 Ground Water

The discussion of ground water mitigation in the 1986 CELV EA is also applicable to proposed program modifications. Strict safety and control procedures will be implemented to prevent significant impacts to ground water.

4.3.2 Surface Water

The discussion of surface water mitigation in the 1986 CELV EA is applicable. No significant impacts to surface waters are expected to result from Titan IV program modifications, and no mitigative measures are necessary. Clean fill from an onsite borrow area will be used for fill activities at the VIB facility. The area to be filled will be contoured to a 4-to-1 slope to prevent erosion.

4.4 BIOTA

Titan IV program modifications should not adversely impact local biota or endangered or threatened species, and no mitigative measures are necessary or proposed.

4.5 POPULATION

4.5.1 Demography and Housing

No significant effects on demography or housing will result from the proposed action, and no mitigation is necessary or proposed.

4.6 SOCIOECONOMICS

4.6.1 Land Use Compatibility

The proposed project modifications are compatible with current and projected future land uses on CCAFB, and no mitigative measures are necessary.

4.6.2 Community Facilities and Services

Existing facilities and services are adequate to support the proposed Titan IV program modifications. These modifications should not significantly affect facilities and services, and no mitigative measures are required.

4.6.3 Economy

The proposed Titan IV program modifications will not have a significant impact on the local economy, and no mitigative measures are required.

4.7 ARCHAEOLOGICAL AND HISTORICAL RESOURCES

The proposed action will not impact any archaeological or historical resources. No mitigative measures are necessary.

4.8 AESTHETICS

No significant visual impact will occur as a result of the proposed Titan IV program modifications, and no mitigative measures are necessary.

4.9 HAZARDOUS WASTES

All hazardous wastes produced by the Titan IV program will be managed in accordance with applicable Federal and state regulations.

4.10 NOISE

The infrequency of launches, their short duration, and the relatively remote location of Launch Complex 41 on the north end of CCAFB will minimize noise impacts of the Titan IV program. Sonic booms will occur primarily over the Atlantic Ocean. The Titan IV program and proposed program modifications are compatible with surrounding land use, and no mitigative measures are proposed.

5.0 LIST OF PREPARERS

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APPENDIX A

WILDLIFE SPECIES LIKELY TO OCCUR ON CCAFB

Table A-1. Selected Animal Species Observed or Likely to Occur on CCAFB

Scientific Name	Common Name	Habitat				
		Coastal Dune and Strand	Scrub	Hammock	Marsh	Mangrove
	Crustaceans					
Ocypode albicans	Ghost crab	X				
	Ichthyofauna					
Lepisosteus platyrhincus	Gar				X	X
Fundulus spp.	Killifish				X	X
Gambusia affinis	Mosquitofish				X	X
Fundulus chrysotus	Top minnow				X	X
Poecilia latipinna	Sailfin molly					X
	Amphibians					
Hyla cinerea	Green treefrog		X			
Bufo quercus	Oak toad		X			
Bufo terrestris	Southern toad		X			
Rana pipiens	Leopard frog				X	
	Reptiles					
Chelonia mydas	Green turtle	X				
Gopherus polyphemus	Gopher tortoise	X	X			
Caretta caretta	Loggerhead turtle	X				X
Terrapene carolina	Box turtle	X	X		X	
Crotalus adamanteus	Eastern diamondback rattlesnake	X	X		X	
Elaphe obsoleta	Rat snake	X	X		X	
Eumeces inexpectatus	Florida skink	X	X			
Coluber constrictor	Black racer		X			
Elaphe guttata	Corn snake		X			

Table A-1. Selected Animal Species Observed or Likely to Occur on CCAFB (Continued, Page 2 of 4)

Scientific Name	Common Name	Habitat				
		Coastal Dune and Strand	Scrub	Hammock	Marsh	Mangrove
Natrix fasciata	Banded water snake				X	
Farancia abocura	Mud snake				X	
Kinosternon subrubrum	Mud turtle				X	
Alligator mississippiensis	Alligator				X	
Chelonia mydas	Green turtle					X
Agkistrodon piscivorus	Water moccasin					X
	Birds					
Anhinga anhinga	Anhinga				X	X
Falco peregrinus	Peregrine falcon			X	X	
Pelecanus occidentalis	Eastern brown pelican	X				X
Cathartes aura	Turkey vulture		X	X		
Coragyps atratus	Black vulture		X	X	X	
Cirus cyaneus	Marsh hawk		X		X	
Falco sparverius	Sparrow hawk		X	X		
Tyto alba	Barn owl		X	X	X	
Otus asio	Screech owl		X	X		
Bubo virginianus	Great horned owl			X	X	
Colinus virginianus	Bob-white		X	X		
Zenaidura macroura	Mourning dove		X	X		
Columbigallina passerina	Ground dove		X	X		
Iridoprocne bicolor	Tree swallow	X	X	X	X	
Quiscalus quiscala	Common grackle			X	X	
Corvus ossifragus	Fish crow				X	X
Geothylpis trichos	Yellow throat		X		X	
Vireo griseus	White-eyed vireo		X	X		
Eriola minutilla	Least sandpiper	X			X	
Fulica americana	American coot				X	
Phalacrocorax auritus	Doubled-crested cormorant				X	X

Table A-1. Selected Animal Species Observed or Likely to Occur on CCAFB (Continued, Page 3 of 4)

Scientific Name	Common Name	Habitat				
		Coastal Dune and Strand	Scrub	Hammock	Marsh	Mangrove
Butorides virescens	Green heron				X	X
Egretta caerulea	Little blue heron				X	X
Laurus atricilla	Laughing gull	X				
Aphelocoma coerulescens	Scrub jay	X	X	X		
Mimus polyglottos	Mockingbird		X			
Pipilo erythrophthalmus	Rufous-sided towhee		X			
Buteo jamaicensis	Red-tailed hawk		X		X	
Haliaeetus leucocephalus	Bald eagle				X	
Ammospiza maritima	Dusky seaside sparrow			X	X	
Pandion haliaetus	Osprey			X	X	
Egretta thula	Snowy egret			X	X	X
Ardea herodias	Great blue heron			X	X	X
Anas fulvigula	Mottled duck			X	X	X
Eudocimus albus	White ibis			X	X	X
Gallinula chloropus	Gallinule				X	
Megaceryle alcyon	Kingfisher				X	
Mycteria americana	Wood stork				X	X
	Mammals					
Lynx rufus	Bobcat		X	X		
Peromyscus polionotus	Oldfield mouse	X				
Spilogale putoris	Eastern spotted skunk	X	X			
Sigmodon hispidus	Cotton rat	X	X		X	
Procyon lotor	Raccoon	X	X		X	
Peromyscus floridanus	Florida mouse		X			
Sylvilagus floridanus	Eastern cottontail		X			

Table A-1. Selected Animal Species Observed or Likely to Occur on CCAFB (Continued, Page 4 of 4)

Scientific Name	Common Name	Habitat				
		Coastal Dune and Strand	Scrub	Hammock	Marsh	Mangrove
Didelphis virginiana	Opossum		X			
Peromyscus gossypinus	Cotton mouse		X		X	
Ochrotomys nuttalli	Golden mouse		X		X	
Sciurus carolinensis	Squirrel					
Sylvilagus palustris	Marsh rabbit				X	
Oryzomys palustris	Rice rat				X	
Lutra canadensis	River otter				X	
Neofiber alleni	Roundtailed muskrat				X	
Trichechus manatus	Manatee					X
Odocoileus virginianus	White-tailed deer		X	X	X	
Dasypus novemcinctus	Nine-banded armadillo	X	X	X		

Source: Adapted from NASA, 1979 (13).